

western Oregon and Washington. In the upper lake region eighteen inches were reported in extreme northern Michigan and north-central Wisconsin; in the Red River of the North valley, sixteen inches at Saint Vincent, Minn.; in South Dakota and northern Nebraska, two to eight inches; in west-central and northwestern Colorado, eight to twenty inches; in the middle and northern plateau regions the amount varied from over forty inches in northeastern Nevada to thirty inches in southeastern Wyoming, to sixteen inches in eastern Washington, to fifteen inches near Carson City, Nev., to twelve inches in southeastern Utah, and in northeastern California a depth of twenty-one inches was reported.

#### HAIL.

Hail was reported during the month as follows: 4th, Cal., Nev. 5th, Md., N. Y., Pa. 6th, N. Y. 8th, Cal. 9th, Wash. 10th, Ill., Ind., Iowa, Kans., Ky., Mich., Mo., N. Y., Ohio, Wis. 11th, and 12th, Cal. 14th, Ind., N. J., N. Y., Ohio,

Pa. 16th, N. C. 18th, Cal., Wash. 19th, Nebr., Oregon, Wash., Wis. 20th, Cal., Oregon. 21st, Cal., Ill., Iowa, Kans., Minn., Mo., Tenn. 22d, Cal., Mass., N. Y. 23d, Mass., Ohio. 24th, Mass., N. Y. 25th, Cal., Mass. 26th, N. Y., Pa. 28th, Iowa, Nebr., S. Dak. 29th, Iowa, Mass. 30th, Md., Ohio, Va. 31st, Iowa, Ohio, Va.

#### SLEET.

Sleet was reported as follows: 1st, Wis. 3d, N. Dak., Pa., S. Dak. 4th, Minn., Wis. 5th, Mich., N. J., N. Y., Ohio, Pa. 6th, Conn., N. J., Vt. 8th, N. Dak., Utah. 9th, N. Dak. 10th, Mass., N. Y., Wis. 11th, Utah, Vt. 13th, Vt. 14th, N. J., Pa., Vt., Wis. 15th, Pa., Vt. 16th, Kans., Minn., N. Dak. 19th, Ill., Iowa, Nebr., Utah, Wis. 20th, Wis. 21st, Iowa, Wash., Wis. 22d, N. H., N. Y., Vt. 23d, Mass. 24th, Conn., Mass. 26th, Conn., N. Y., Vt., Wash. 27th, Utah. 28th, Colo., Minn., Nebr., S. Dak., Wis. 29th, Colo., Iowa, Minn., Oregon, Pa., Tenn., Vt., Wis. 31st, Ariz., Iowa, N. C.

#### WINDS.

The prevailing winds during December, 1889, are shown on chart ii by arrows flying with the wind. In New England, the prevailing winds were from the northwest to west; in the middle Atlantic and east and west Gulf states, the upper Mississippi and Missouri valleys, and over the northern plateau region, southeast to southwest; in the south Atlantic states and on the northeastern slope of the Rocky Mountains, west to southwest; in Florida, northeast to northwest; in the Rio Grande Valley, and on the middle Pacific coast, southeast; in the Ohio valley and Tennessee, and on the southeastern slope of the Rocky Mountains, south to southwest; in the lower lake region, southwest; in the upper lake region, and over the middle plateau region, south to west; in the extreme northwest, north to northwest; on the middle-eastern slope of the Rocky Mountains, south to northwest; on the north Pacific coast, south to southeast; on the south Pacific coast, east to northeast; and over the southern plateau, variable.

#### HIGH WINDS (in miles per hour).

Maximum velocities of fifty miles, or more, per hour were reported at regular stations of the Signal Service as follows: 2d, 51, sw., at Wood's Holl, Mass. 6th, 52, sw., at Whipple

Barracks (Prescott), Ariz. 7th, 50, sw., at Whipple Barracks (Prescott), Ariz. 10th, 50, sw., at Lexington, Ky. 14th, 60, ne., at Block Island, R. I. 15th, 54, s., at Whipple Barracks (Prescott), Ariz. 16th, 56, se., at Fort Canby, Wash. 19th, 60, se., at Fort Canby, Wash. 20th, 56, w., at Buffalo, N. Y. 22d, 50, sw., at Port Huron, Mich.; 72, w., at Buffalo, N. Y.; 54, w., at Rochester, N. Y.; and 56, w., at Grand Haven, Mich. 26th, 54, w., at Boston, Mass.; 54, nw., at Block Island, R. I.; 65, w., at Buffalo, N. Y.; 57, w., at Port Huron, Mich.; 54, w., at Harrisburg, Pa.; and 52, w., at Oswego, N. Y. 27th, 60, nw., at Wood's Holl, Mass.; and 50, se., at Fort Canby, Wash. 28th, 60, s., at Dodge City, Kans. 29th, 66, w., at Buffalo, N. Y.; 51, sw., at Grand Haven, Mich.; and 67, sw., at Port Huron, Mich. 31st, 54, s., at Dodge City, Kans.

#### LOCAL STORMS.

Heavy thunder-storms were reported near Cambridge, Ind., on the 11th, and at Buffalo, N. Y., on the 22d. Destructive gales were reported at Jeannette, Pa., on the 11th; over the lower lake region on the 22d; over New England and the lake region on the 26th; on the middle Atlantic and New England coasts on the 27th; at Fort Sully, South Dakota, on the 28th; and at Port Huron, Mich., on the 29th.

#### INLAND NAVIGATION.

##### CLOSING OF NAVIGATION.

*Lake Michigan.*—Grand Haven, Mich.: navigation closed for the season on the 1st, but steamers will run between this port and Milwaukee throughout the winter. Chicago, Ill.: navigation closed for the season on the 15th.

*Green Bay.*—Green Bay, Wis.: navigation was practically closed for the season on the first.

*Lake Superior.*—Duluth, Minn.: navigation closed for the season on the 4th.

*Kennebec River.*—Augusta, Me.: the river froze over on the night of the 3d–4th from this city to Merry Meeting Bay, and reports from Gardiner, Me., stated that the river also froze over at that point.

*Saint Olair River.*—Port Huron, Mich.: the last boats of the season, en route from Chicago to Buffalo, passed this port on the 11th.

*Saint Mary's River.*—Sault de Ste. Marie, Mich.: navigation closed for the season on the 4th.

*Missouri River.*—Yankton, S. Dak.: navigation opened on the 8th. The river froze over on the 28th, closing navigation.

*Mississippi River.*—Saint Paul, Minn.: the ice-gorge in the river disappeared early in the morning of the 8th, and the

channel was clear as far as the eye could reach. A small gorge formed during the night of the 19–20th, and another during the night of the 26–27th. Davenport, Iowa: owing to an ice gorge which formed above this place, the stage of the water on the 1st and 2d, 0.2 and 0.3, respectively, below low-water mark, was the lowest on record, the former lowest mark being zero, in 1878. La Crosse, Wis.: the river was nearly clear of ice on the 2d, and the ferry boat resumed her trips; floating ice 25th to 27th. The ferry boat stopped running on the 29th. The river was frozen over on the 30th, on which date the water was reported the lowest ever known.

#### FLOODS.

Heavy and continuous rains caused destructive floods in California and parts of Nevada and Arizona, and heavy rain caused the rivers at Johnstown, Pa., to rise to a dangerous height on the 14th. On the 12th the Sacramento River at Sacramento, Cal., was the highest ever known, the gauge reading being twenty-six feet eleven and one-half inches; the highest previous reading was twenty-six and six-tenths feet, in February, 1881. The levee opposite Sacramento broke, flooding a great part of Yolo county. Colusa county sustained greater damage than any of the surrounding sections,

on account of the extensive grain fields in that county, which were washed out. At Los Angeles, Cal., the heavy rains previous to the 15th caused considerable damage to the railroads, and the train service of the Southern Pacific and Santa Fé systems was interrupted by washouts. The Southern Pacific Railroad suffered severely on the deserts west of Yuma, Ariz., where a storm of unusual severity prevailed. Traffic was interrupted on the Santa Fé road by land slides in Cajon Pass, and all communication was cut off from San Diego, on the coast line, by washouts. The bridges on the California Southern Railroad between Santa Ana and Los Angeles were washed away on the 23d. At Los Angeles the heavy rains from the 22d to 26th caused considerable damage; streets were badly washed and the railroad bridges were generally destroyed. The Los Angeles River changed its channel south of the city, flooding the surrounding country. At Red Bluff, Cal., the high water, resulting from continuous rains previous to the 14th, was very destructive to bridges, etc. Reports state that in Tehama county the damage to public property will amount to \$40,000, while individual losses will aggregate \$250,000, and that adjoining counties to the southward suffered even greater injury from high water. The Rio Virgin River rose so high in the southern part of Lincoln Co., Nev., under the unprecedented rainfall, that it overflowed its banks in many places and changed its course, washing away everything in its path. Lake Tahoe is reported as having risen twelve inches. On the 5th the Salt and Verde rivers, in Arizona, rose very rapidly, and at Fort McDowell the Verde River overflowed its banks, flooding the adjacent lowlands. On the 6th, at Fort Verde, Ariz., the Verde River was higher than it has been during the last fifteen years, and considerable damage was caused along the river by the inundation of alfalfa fields, washing out of dams, etc.

#### STAGE OF WATER IN RIVERS AND HARBORS.

The following table shows the danger-points at the several

stations; the highest and lowest water during December, 1889, with the dates of occurrence and the monthly ranges:

*Heights of rivers above low-water mark, December, 1889 (in feet and tenths).*

Stations.	Danger-point on gauge.	Highest water.		Lowest water.		Monthly range.
		Date.	Height.	Date.	Height.	
<i>Red River:</i>						
Shreveport, La.....	29.9	8, 9, 10, 11	18.2	31	11.5	6.7
<i>Arkansas River:</i>						
Fort Smith, Ark....	22.0	1	8.4	31	2.0	6.4
Little Rock, Ark....	23.0	1	14.3	31	4.2	10.1
<i>Missouri River:</i>						
Fort Buford, Dak.*						
Kansas City, Mo....	21.0	1	4.3	9, 15, 27, 28	3.2	1.1
<i>Mississippi River:</i>						
Saint Paul, Minn.*	14.5					
La Crosse, Wis.*	24.0					
Dubuque, Iowa....	16.0	13	2.2	4, 5, 6	0.9	1.3
Davenport, Iowa....	15.0	13	1.1	1, 2	0.2	1.3
Keokuk, Iowa....	14.0	16, 17	0.4	5	0.7	1.1
Saint Louis, Mo....	32.0	15	6.2	9	3.8	2.4
Cairo, Ill.....	40.0	2	29.5	14	17.3	12.2
Memphis, Tenn....	34.0	4	23.1	16	12.8	10.3
Vicksburg, Miss....	41.0	9	28.7	22, 23	19.0	9.7
New Orleans, La..	13.0	14	9.2	31	6.0	3.2
<i>Ohio River:</i>						
Pittsburgh, Pa....	22.0	15	15.1	8	5.9	9.2
Parkersburg, W. Va.	38.0	14	20.0	6	8.5	11.5
Cincinnati, Ohio....	50.0	1	29.9	10	16.6	13.3
Louisville, Ky.....	25.0	1	11.9	11	8.2	3.7
<i>Cumberland River:</i>						
Nashville, Tenn....	40.0	1	19.2	20, 21	5.5	13.7
<i>Tennessee River:</i>						
Chattanooga, Tenn.	33.0	1	7.7	22, 23	3.5	4.2
Knoxville, Tenn....		1	3.7	15-21	1.0	2.7
<i>Monongahela River:</i>						
Pittsburgh, Pa....	29.0	15	15.1	8	5.9	9.2
<i>Savannah River:</i>						
Augusta, Ga.....	32.0	1	8.2	29, 30	6.9	1.3
<i>Willamette River:</i>						
Portland, Oregon...	15.0	12	4.1	18	0.2	3.9

\*Frozen.

#### LOW TIDE.

At New London, Conn., the lowest tide noted for many years occurred on the 23d.

### ATMOSPHERIC ELECTRICITY.

#### AURORAS.

Fort Buford, N. Dak.: a faint auroral display of a light yellow tint was observed in about azimuth 40° and altitude 8° at 11.12 p. m., 13th, and continued without any marked change until 1.40 a. m., 14th. Another aurora was observed at 10.48 p. m., 26th. It consisted of an irregular arch resting on a well-defined dark base, which extended over about 75° of azimuth from northwest to northeast, and rose to about altitude 25°. The color was white through the centre of the arch, and the outer edges were of a yellow tint. Up to 1.15 a. m. of the 27th the aurora remained unchanged, and a few traces were still visible at 7.15 a. m.

Hartford, Conn.: an auroral display was first observed at 8.55 p. m., 15th; stripes of light, interspersed with clear sky, covered 40° of the horizon, and rose half way up to the zenith.

Leaf River, Ill., 26th: very high tension on telegraph lines, and long circuits working strong and clear were followed at night by a bright auroral arch, which was visible as late as 12.30 a. m., 27th.

Fort Maginnis, Mont.: an aurora was observed in the northeast from 1.36 a. m. until 3 a. m. 27th. It consisted of luminous beams, which rose to altitude 45° and extended from about azimuth 180° to 270°. The color of the display was of a pale yellow and red.

Auroras were observed during the month as follows: 3d, Setauket, N. Y. 4th, Seven Pines, W. Va. 12th, Cresco, Iowa. 13th, Carson, Iowa. 14th, Fort Buford, N. Dak.; Webster, S. Dak. 15th, Hartford, Conn.; Dana, Ind.; Wah-

peton, N. Dak. 16th, Orono, Me. 18th, Greenwood, Wis. 21st, Orono, Me.; Fort Assiniboine, Mont.; Leech Farm, N. Dak. 22d, Fort Assiniboine, Mont.; Webster, S. Dak. 24th, Liberty, Va.; Tannery, W. Va. 26th, Winnebago, Ill.; Cresco and Maquoketa, Iowa; Fort Buford and Wahpeton, N. Dak.; Grantsburgh and Madison, Wis. 27th, Leaf River, Ill.; Berrien Springs, Mich.; Fort Maginnis, Mont.; Nashua, N. H.; Lyons, N. Y. 29th, Delavan, Wis.

#### THUNDER-STORMS.

Thunder-storms were reported in the greatest number of states and territories, fourteen, on the 21st; in twelve, on the 10th; in from six to ten, inclusive, on the 20th, 22d, 24th, 25th, 26th, 28th and 29th; and in from one to four, inclusive, on the 3d to 9th, 11th, 13th to 19th, 23d, 30th, and 31st. The 1st, 2d, 12th, and 27th were the only dates on which no thunder-storms were reported.

Thunder-storms were reported on the greatest number of dates, sixteen, in Michigan; on twelve in Illinois and Indiana; on ten in California; on nine in Ohio; on seven in Kansas and Missouri; and on from one to six, inclusive, in Alabama, Arizona, Arkansas, Indian Territory, Iowa, Kentucky, Louisiana, Massachusetts, Minnesota, Mississippi, Nebraska, New Jersey, New York, Oregon, Pennsylvania, South Dakota, Tennessee, Texas, Virginia, West Virginia, and Wisconsin. In states and territories other than those named no thunder-storms were reported.

Leaf River, Ill.: high electrical tension with severe electrical shocks, but absence of thunder and lightning, were noted at 3.50 p. m., 21st.